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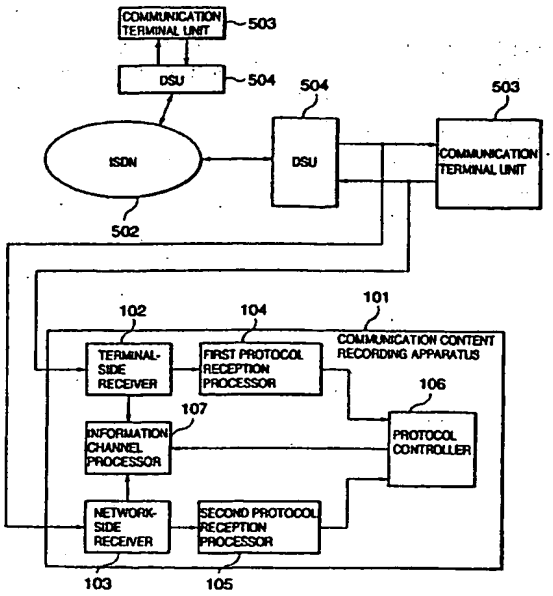
(54) Communication content recording apparatus and method

(57) A communication content recording apparatus supporting a digital communication such as ISDN is provided. A communication content recording apparatus 101 includes receivers 102, 103 for receiving data transmitted/received between communication terminal units 503 through ISDN 502, protocol processors 104, 105 for processing a frame on a signal channel received by the receiver 102, 103 according to a protocol, an information channel processor 107 for converting the data on the information channel received by the receivers 102, 103 to data whose format is compatible with being recorded in a recording medium, and a protocol controller 106 for controlling start and stop of the processing of the information channel processor 107 according to messages which are obtained on the basis of a processing result in the protocol processors 104, 105.

FIG.1



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transmission and reception sequence numbers is modulo (mod) 128 in which numerical values of 0 to 127 are repeatedly used (for example, 0, 1, 2, .., 126, 127, 0, 1, 2, ...). For example, an information frame which is first transmitted is allotted with a transmission sequence number "0", and an information frame which is secondly transmitted is allotted a transmission sequence number "1". At this time, if the reception side has not yet received any information frame, the reception sequence number of an information frame transmitted by the reception side is equal to "0". If the reception side receives an information frame, the reception sequence number of an information frame transmitted by the reception side is equal to "1".

[0014] As the surveying frame, there are provided a reception ready (RR) frame for notifying the transmission sequence number of a frame to be next received (the number of frames which have been received) to a communication partner with which communications are being made when no information frames have been generated for a predetermined time period, and a reject (REJ) frame for detecting, on the basis of the transmission sequence number of the frame thus received, a frame which could not be received due to a transmission error, and requesting re-transmission of the missing frame. Like the information frame, a reception sequence number is also affixed to the surveying frame. In the case of the RR frame, it represents the transmission sequence number of a frame to be next received (the number of frames which have been received), and in the case of the REJ frame, it represents the transmission sequence number of a frame which could not be received due to a transmission error.

[0015] As the unnumbered frame, there are provided a set asynchronous balanced mode extended (SABME) frame, an unnumbered information (UI) frame, a disconnect (DISC) frame, an unnumbered acknowledgment (UA) frame, etc.

[0016] Next, a conventional communication system using ISDN will be described.

[0017] Fig. 12 is a schematic diagram showing a conventional communication system using ISDN.

[0018] As shown in Fig. 12, a communication terminal unit 503 is connected to ISDN 502 through DSU 504. DSU 504 performs a control operation to physically connect the communication terminal unit 503 and ISDN 502. The communication terminal unit 503 includes a receiver 505, an LAPD reception processor 506, a transmitter 507, an LAPD transmission processor 508, a layer 3 protocol processor 509 and an information channel processor 510 for processing data on the information channel.

[0019] The receiver 505 receives information (data) transmitted through DSU 504 from ISDN 502. It outputs the data on the signal channel to the LAPD reception processor 506 and also outputs the data on the information channel to the information channel processor 510.

[0020] The LAPD reception processor 506 obtains a frame format, a frame type, information transmission procedure, etc. from the LAPD frame on the signal channel to manage information received/transmitted through the signal channel.

[0021] The LAPD reception processor 506 performs error detection on the basis of a frame check sequence portion of an LAPD frame, and also surveys continuity of transmission sequence numbers of LAPD frames received to thereby perform defect detection of the LAPD frames. When an error is detected or an LAPD frame has a defect, the LAPD transmission processor 508 transmits a re-transmission request through the transmitter 507 to ISDN 502.

[0022] The layer 3 protocol processor 509 surveys the communication status between the communication terminal unit 503 thereof and ISDN 502 to control communications with ISDN 502 on the basis of messages such as call-establishment, call-release, etc. For example, when information is transmitted to a communication partner, the LAPD transmission processor 508 and the transmitter 507 are controlled so that control information is generated and transmitted together with information generated in the information channel processor 510.

[0023] In the conventional communication system using ISDN thus constructed, messages are communicated on the signal channel between the communication terminal unit 503 and ISDN 502 to perform establishment or release of call of an information channel or selection of an information channel. When an error is detected in the communication of a message, the system is restored from the error by re-transmitting the message.

[0024] Fig. 13 is a flowchart showing the processing in the above conventional communication system using ISDN when a communication terminal unit receives an error frame.

[0025] When an error occurs in the data transmission from ISDN 502 to the communication terminal unit 503 or from the communication terminal unit 503 to ISDN 502 in Fig. 12, the processing is carried out according to the flow shown in Fig. 13.

[0026] In a case of the signal channel for performing the data transmission from ISDN 502 to the communication terminal unit 503, when the receiver 505 receives an LAPD frame (step S701), the LAPD reception processor 506 first judges whether or not the LAPD frame received is an error frame (step S702). If the LAPD frame received is not any error frame, the processing is carried out according to the content of the LAPD frame (step S703).

[0027] On the other hand, if the LAPD frame is an error frame, the error frame is discarded (step S704). The LAPD transmission processor 508 transmits a re-transmission request through the transmitter 507 to ISDN 502 (step S705). The LAPD reception processor 506 neglects information which has been received during a time period from the reception of the error frame until

the information channel to the recordable data can be started, and when it contains a message for call release, the conversion processing concerned can be stopped. Accordingly, in communications through a digital communication network, the communication content can be recorded without affecting concerned parties in communication with each other.

[0039] In the first aspect of the present invention, when a processing result of the protocol processing means indicates that the frame received is an error frame, the protocol controlling means may be designed to presume the content of the error frame on the basis of a processing result of the protocol processing means for a frame received immediately before the error frame if the reception means does not receive a next frame within a predetermined time lapse after receiving the error frame, or according to a processing result of the protocol processing means for the next frame. With this operation, the communication content can be normally recorded even when an error frame is received.

[0040] For example, when an error frame is received because of occurrence of troubles between communication terminal units in communication, the communication terminal unit at the frame reception side also receives an error frame. Therefore, a re-transmission-request frame is transmitted from the communication terminal unit concerned or the digital communication network to the digital communication network or the communication terminal unit at the frame transmission side. Accordingly, when the frame received subsequent to the error frame is a re-transmission-request frame, the frame which was judged to be the error frame is re-transmitted from the digital communication network or the communication terminal units at the frame transmission side. Therefore, the error frame can be merely discarded.

[0041] However, when an error frame is received although the normal communication is performed correctly between the communication terminal units in communication, the re-transmission-request frame is not transmitted from the communication terminal unit or the digital communication network at the frame reception side to the digital communication network or the communication terminal unit at the frame transmission side. Therefore, there may arise such a case that merely discarding the error frame cannot have the communication content be correctly recorded when the error frame contains a message for call establishment or call release.

[0042] Therefore, in a case where a processing result of the protocol processing means indicates the error frame, the start/stop of the recording of the communication data can be performed correctly by presuming the content of the error frame from a processing result of the frame received immediately before the error frame at the protocol processing means if the receiving means does not receive a next frame within a predetermined time period after receiving the error frame or the frame which is received subsequently to the error frame by the reception means is not a re-transmission-request frame.

[0043] Further, according to a second aspect of the present invention, a communication content recording apparatus for recording the content of communications which are carried out between communication terminal units through a digital communication network, includes:

receiving means for receiving data on a signal channel and data on an information channel which are received/transmitted between the digital communication network and the communication terminal units;

frame processing means for extracting frames from the data on the signal channel received by the receiving means and outputting the extracted frames;

information channel processing means for processing the data on the information channel received by the receiving means so that the processed data are recordable;

protocol controlling means for controlling the start/stop of the processing of the information channel processing means according to a message contained in a frame output from the frame processing means; and

frame missing detection means for surveying continuity of frames output from the frame processing means to detect frame missing, wherein the protocol controlling means controls the start/stop of the processing of the information channel processing means for the information channel concerned in accordance with the progress of a call establishment or call release procedure of the information channel when the frame missing is detected by the frame missing detection means.

[0044] According to the second aspect of the present invention, the continuity of the frames which are communicated on the signal channel are monitored, and when a frame missing occurs, the start/stop of the processing of the information channel processing means for the information channel is controlled in accordance with the progress of the call establishment or call release of the information channel which is defined in the protocol between the communication terminal unit and the digital communication network. With this operation, even when a frame missing occurs, the start/stop of the recording of the communication content can be performed correctly.

[0045] In the second aspect of the present invention, when a frame extracted from the data on the signal channel received by the receiving means is an error frame, the frame processing means may discard the frame concerned without delivering it to the protocol controlling means. With this operation, the treatment of the frame missing and the error frame can be performed according to the same procedure with no discrimination therebetween so that the start/stop of the recording of the communication content can be performed correctly.

[0056] The second protocol reception processor 105 obtains an LAPD frame based on the protocol of LAPD from the data on the signal channel which are obtained through the network-side receiver 103 and transmitted from ISDN 502, and identifies a frame format, a frame type and information transmission procedure thereof on the basis of the LAPD frame thus obtained. Further, it judges whether a message is a message for call establishment or call release on the basis of the identification result, and outputs the content thereof to the protocol controller 106.

[0057] The protocol controller 106 surveys the communication status between ISDN 502 and the communication terminal unit 503 according to the messages of the frame on the signal channel which are output from the first protocol reception processor 104 and the second protocol reception processor 105. Further, it outputs an instruction to the information channel processor 107 to control the recording of the communication content on the information channel.

[0058] In response to the instruction from the protocol controller 106, the information channel processor 107 converts the data on the information channel received by the terminal-side receiver 102 and the network-side receiver 103 to data whose format is conformable to the recording into the recording medium, and then transfers the data thus converted to a recorder (not shown).

[0059] Next, the operation of the communication content recording apparatus 101 of this embodiment will be described.

[0060] Prior to the description of the operation, the processing procedure from the line connection between the communication terminal units 503 until the line disconnection therebetween which is carried out through ISDN 502 will be first described.

[0061] Fig. 2 is a diagram showing a processing procedure from the line connection between the communication terminal units 503 until the line disconnection therebetween which is carried out through ISDN 502 in the communication system shown in Fig. 1. In the following description, a user's communication terminal unit 503 at a calling side is referred to as a calling-side terminal unit 503, and a user's communication terminal unit 503 at a called side is referred to as a called-side terminal unit 503.

[0062] As shown in Fig. 2, the calling-side terminal unit 503 first transmits a call-setup (SETUP) message 151 through the signal channel to ISDN 502. Upon receiving this message 151, ISDN 502 returns a call proceeding (CALL PROCEEDING) message 152 to the calling-side terminal unit 503 through the signal channel, and also transmits a call-setup message 153 to the called-side terminal unit 503.

[0063] The called-side terminal unit 503 which receives the call-setup message 153 transmits a call proceeding message 154 through the signal channel to ISDN 502, and also transmits an alerting (ALERTING) message 155 for notifying that it is now under alerting. Upon receiving this message, ISDN 502 transmits an alerting message 156 to the calling-side terminal unit 503 through the signal channel.

[0064] Next, the called-side terminal unit 503 responds to the alerting message to transmit a connect (CONNECT) message 157 to ISDN 502. Upon receiving this message, ISDN 502 transmits a connect message 158 through the signal channel to the calling-side terminal unit 503 and also transmits a connect acknowledge (CONNECT ACK) message 159 to the called-side terminal unit 503.

[0065] According to the above procedure, "call" is set up, and the communication using the information channel between the calling-side terminal unit 503 and the called-side terminal unit 503 can be performed.

[0066] In a case where the communication using the information channel between the calling-side terminal unit 503 and the called-side terminal unit 503 is completed, for example when the calling-side terminal unit 503 completes the communication using the information channel with the called-side terminal unit 503, the completion of the communication is performed according to the following procedure.

[0067] First, the calling-side terminal unit 503 transmits a disconnection (DISCONNECT) message 160 requesting disconnection through the signal channel to ISDN 502. Upon receiving this message, ISDN 502 transmits a disconnection message 161 through the signal channel to the called-side terminal unit 503.

[0068] The called-side terminal unit 503 which receives the disconnection message 161 transmits a release (RELEASE) message 162 requesting release through the signal channel to ISDN 502. Upon receiving this message, ISDN 502 transmits a release complete (RELEASE COMPLETE) message 163 to the called-side terminal unit 503 through the signal channel.

[0069] At the same time, ISDN 502 transmits a release message 164 through the signal channel to the calling-side terminal unit 503. Upon receiving this message, the calling-side terminal unit 503 transmits a release complete message 165 through the signal channel to ISDN 502.

[0070] Through the above procedure, the line is disconnected and the communication is completed.

[0071] The communication content recording apparatus 101 of this embodiment surveys the delivery of messages on the signal channel between the communication terminal unit 503 and ISDN 502 by using the protocol controller 106, and it controls the information channel processor 107 in accordance with the content of the messages to control the start/stop of the recording of the communication content on the information channel.

[0072] Fig. 3 is a flowchart showing the processing of the communication content recording apparatus 101 according to the present embodiment.

[0073] The protocol controller 106 surveys, through the terminal-side receiver 102 and the first protocol reception processor 104 or through the network-side re-

reception processor 104 and the second protocol reception processor 105). If the next frame is not received within a predetermined time period after the error frame is received, error frame corrective processing as described later is performed, and a message which would be originally contained in the error frame is presumed on the basis of the frame received immediately before the error frame. Further, even when the next frame is received within the predetermined time period after the error frame is received, the same error frame corrective processing is carried out if a message contained in the next frame received is out of the re-transmission request, whereby the message which would be originally contained in the error frame is presumed on the basis of the frame received immediately before the error frame.

[0085] Next, the operation of the communication content recording apparatus 201 of this embodiment will be described.

[0086] Fig. 5 is a flowchart showing the processing of the communication content recording apparatus 201 of this embodiment.

[0087] The protocol controller 106a judges through the terminal-side receiver 102 and the first protocol reception processor 104 or through the network-side receiver 103 and the second protocol reception processor 105 whether or not a frame on the signal channel is received (step S11). If any frame is judged to be received on the signal channel, the processing goes to step S12, and if no frame is received on the signal channel, the processing goes to step S13.

[0088] In step S12, it is judged whether or not the frame received in step S11 is an error frame. If the frame is judged to be an error frame, the timer 108 is executed (step S14), and then the processing returns to step S11. On the other hand, if the frame is judged not to be an error frame, the timer 108 is stopped (if the timer is executed) (step S15), and the processing then goes to step S16.

[0089] In step S16, it is judged whether or not the frame received in step S11 is a re-transmission-request frame. If the frame is judged to be the re-transmission-request frame, it may be presumed that an error frame has occurred in the communication between the communication terminal unit 503 and ISDN 502 and therefore the communication terminal unit 503 at the error-frame reception side or ISDN 502 transmits a re-transmission request to the communication terminal unit 503 at the error frame transmission side or ISDN 502. In this case, in the communication content recording apparatus 201, if the error frame is received prior to reception of the re-transmission-request frame, the error frame concerned is discarded (step S17), and the processing then returns to step S11. On the other hand, if the frame received in step S11 is not the re-transmission-request frame, the processing goes to step S18.

[0090] In step S18, it is judged whether or not a frame received immediately before the processing target frame (the frame which is received through the step S11 executed immediately before), that is, the frame received through the step S11 which is executed immediately before the immediately-before executed step S11 is an error frame. If the frame concerned is not any error frame, the processing goes to step S20. On the other hand, if the frame concerned is an error frame, it may be presumed that the delivery of the messages on the signal channel between the communication terminal unit 503 and ISDN 502 is performed correctly, but the next frame is transmitted without transmitting any re-transmission request because the error frame occurs between the communication content recording device 201 and the communication terminal unit 503 or ISDN 502 for some reason. In this case, in accordance with the content of the message which would be originally contained in the error frame, there may occur a case where the recording of the communication content on the information channel cannot be performed correctly. Therefore, the processing goes to step S19 to perform the error frame corrective processing to presume the message which would be originally contained in the error frame. The error frame corrective processing will be described later.

[0091] In step 13, when the timer 108 is executed, it is judged whether or not the timer 108 concerned is timed-out. When the timer 108 is not executed, or when the timer 108 is executed, but it is not time-out, the processing goes to step S11. On the other hand, when the timer 108 is timed-out, it may be presumed that an error frame occurs between the communication content recording apparatus 201 and the communication terminal unit 503 or between the communication content recording apparatus 201 and ISDN 502 for some reason, and a next frame is not received within a predetermined time period (this time period is preferably set in consideration of the minimum value of communication time of a single frame) after the error frame is received because the communication on the information channel has been already executed correctly or completed between the communication terminal units 503 although the timer 108 is started in step S14. In this case, with respect to the special content of the message which would be originally contained in the error frame, there may occur a case where the recording of the communication content on the information channel cannot be performed correctly. Therefore, as in the case of the step S18, the processing goes to step S19 to perform the error frame corrective processing to presume the message which would be originally contained in the error frame.

[0092] In step S20, it is judged that whether or not the processing target frame contains a connect message or a connect acknowledge message. If it contains the connect message or the connect acknowledge message, the processing goes to step S21 to output an instruction to start the processing to the information channel processor 107. Upon receiving the instruction, the information channel processor 107 starts the processing of con-

cation content on the information channel even when an error is detected in a frame on the signal channel as in the case of the above-described communication content recording apparatus of the second embodiment. However, in addition to the effect of the second embodiment, the third embodiment has an effect of more accurately controlling the start/stop of the recording of the communication content on the information channel even when a defective occurs in a frame on the signal channel. Therefore, the construction and operation of the third embodiment are different from those of the communication content recording apparatus of the second embodiment.

[0106] Fig. 7 is a schematic diagram showing a communication system to which a communication content recording apparatus of the third embodiment of the present invention is applied. In Fig. 7, the communication terminal unit 503, DSU 504 and ISDN 502 are the same as those shown in Fig. 12, and the detailed description thereof is omitted.

[0107] The difference between the communication content recording apparatus 301 and the communication content recording apparatus 101 shown in Fig. 1 resides in the fact that the protocol controller 106 is replaced with a protocol controller 106b, the first protocol reception processor 104 is replaced with a first frame reception processor 109 and a first error check reception processor 110, the second protocol reception processor 105 is replaced with a second frame reception processor 111 and a second error check reception processor 112, and a frame continuity detector 113 is further provided. The other constituent elements are the same as those of the communication content recording apparatus 101 of the first embodiment. These constituent elements are represented by the same reference numerals, and the detailed description is omitted from the following description.

[0108] The first frame reception processor 109 extracts an LAPD frame as shown in Fig. 11 by detecting a flag from data on the signal channel which are received by the terminal-side receiver 102, and outputs the LAPD frame thus extracted to the first error check reception processor 110.

[0109] The second frame reception processor 111 extracts an LAPD frame as shown in Fig. 11 by detecting a flag from data on the signal channel which are received by the network-side receiver 103, and outputs the LAPD frame thus extracted to the second error check reception processor 112.

[0110] The first error check reception processor 110 detects a frame error on the basis of a frame check sequence portion which is added to the LAPD frame received from the first frame reception processor 109. The first error check reception processor 110 discards the LAPD frame (error frame) thus received if a frame error is detected, and delivers the LAPD frame thus received to the protocol controller 106b if no frame error is detected.

[0111] The second error check reception processor 112 detects a frame error on the basis of a frame check sequence portion which is added to the LAPD frame received from the second frame reception processor 111. It discards the LAPD frame (error frame) thus received if a frame error is detected, and delivers the LAPD frame thus received to the protocol controller 106b if no frame error is detected.

[0112] The frame continuity detector 113 detects frame missing by using a transmission sequence number, a reception sequence number added to the LAPD frame output to the protocol controller 106b from each of the first error check reception processor 110 and the second error check reception processor 112, thereby checking continuity of frames.

[0113] The protocol controller 106b extracts a message from the LAPD frame received from the first error check reception processor 110 and the second error check reception processor 112 on the basis of a frame format, a frame type and the information transmission procedure, and surveys the communication status between ISDN 502 and the communication terminal unit 503 according to the extracted message to control the information channel processor 107, thereby controlling the recording of the communication content on the information channel.

[0114] When a frame output from the first error check reception processor 110 or the second error check reception processor 112 is missed in the frame continuity detector 113 (for example, a frame is discarded because a frame error occurs in the first error check reception processor 110 or the second error check reception processor 112, or the terminal-side receiver 102 or the network-side receiver 103 cannot receive a frame because the frame itself is missing), the protocol controller 106b controls the information channel processor 107 on the basis of a judgment as to whether "call" of the information channel is established or released, thereby controlling the recording of the communication content on the information channel.

[0115] Next, the operation of the communication content recording apparatus 301 of the present embodiment will be described.

[0116] Before the operation of the communication content recording apparatus 301 is described, the processing procedure from the establishment of the link of the layer 2 between the communication terminal unit 503 and ISDN 502 through the establishment and release of "call" of the layer 3 until the release of the link of the layer 2, which is partially overlapped with the description made with reference to Fig. 2, will be described.

[0117] Fig. 8 is a diagram showing a processing procedure from the establishment of the link of the layer 2 between ISDN 502 and the communication terminal unit 503 through the establishment and release of "call" of the layer 3 until the release of the link of the layer 2 in the communication system shown in Fig. 7.

release complete message 265 transmitted from the communication terminal unit 503 to ISDN 502 is received, the recording of the data on the corresponding information channel is stopped.

[0129] When the communication content recording apparatus 301 of the present embodiment receives an error frame on the signal channel, the following cases may be considered. One case is that the frame itself which is communicated between ISDN 502 and the communication terminal unit 503 is an error frame and thus the error frame is also received in the communication content recording apparatus 301, and the other case is that an error occurs only in the frame received by the communication content recording apparatus 301 for some reason such as a connection environment or the like although the frame reception/transmission is performed correctly between ISDN 502 and the communication terminal unit 503. Further, when an error occurs in the flag for detecting a frame, the frame itself is missed.

[0130] As described above, the communication content recording apparatus 301 is designed to have no transmission function to ISDN 502 and the communication terminal unit 503 so that the communication between ISDN 502 and the communication terminal unit 503 is not affected by the communication content recording apparatus 301. Accordingly, even when an error frame is received or lack of a frame is detected, the communication content recording apparatus 301 cannot make a re-transmission request. Therefore, when only the frame input to the communication content recording apparatus 301 is an error frame or the lack of a frame is detected, there may be a case where the normal recording control cannot be performed if these frames contain messages associated with the start or stop of the recording.

[0131] Therefore, in the communication content recording apparatus 301 of the present embodiment, error frames and the lack of frames are detected by monitoring the continuity of frames, and when they are detected, the establishment or release of "call" of the information channel is monitored, whereby the recording control of the information channel can be performed correctly.

[0132] Fig. 9 is a flowchart showing the processing of the communication content recording apparatus 301 of the present embodiment. This flow is executed for each of the frame output from the first error check reception processor 110 and the frames output from the second error check reception processor 112. That is, the flow shown in Fig. 9 is independently and separately executed for each of the frame transmission on the signal channel from the communication terminal unit 503 to ISDN 502 and the frame transmission from ISDN 502 to the communication terminal unit 503. The following description is given of a case where the flow shown in Fig. 9 is executed on the frame output from the first error check reception processor 110.

[0133] The protocol controller 106b is on standby to receive a frame on the signal channel which is transmitted from the communication terminal unit 503 through the first error check reception processor 110 to ISDN 502 (step S51). When a frame is received, the processing goes to step S52 to judge whether or not the frame thus received is an unnumbered frame to which no sequence number is affixed. If the frame is an unnumbered frame, the processing returns to step S51 and waits to receive a next frame. On the other hand, if the frame is not an unnumbered frame, that is, the frame is a frame affixed with a sequence number, the processing goes to step S53.

[0134] In step S53, it is judged whether or not the received frame is a surveying frame. As described above, the surveying frame is a frame for checking the establishment of the link of the layer 2 between ISDN 502 and the communication terminal unit 503. As surveying frames, there are provided a receive-ready (RR) frame for notifying a communication partner of the number of received frames (the transmission sequence number of a frame to be next received), a re-transmission request (REJ) frame for requesting re-transmission of a missing frame whose sequence number is missed when the sequence number of a received frame is not sequential to the sequence number of a frame received immediately before the frame concerned, etc.

[0135] If it is judged in step S53 that the received frame is a surveying frame, the processing goes to step S54 to judge whether or not the surveying frame is a re-transmission request frame. If the surveying frame is the re-transmission request frame, it is presumed that the communication terminal unit 503 transmits the re-transmission request frame because the frame communication on the signal channel cannot be performed correctly between ISDN 502 and the communication terminal unit 503 and thus an error frame occurs.

[0136] In this case, in accordance with the reception sequence number of the re-transmission request frame, the missing frame having the corresponding transmission sequence number registered in the processing of step S56 (frame continuity check processing) of the flow of Fig. 9 which is executed for the frame output from the second error check reception processor 112 is released (step S55). Thereafter, the processing returns to step S51, and waits to receive a next frame.

[0137] On the other hand, if the frame is not a re-transmission request frame, the processing goes to step S56 to check the continuity of the sequence number of the frame (which is transmitted from the communication terminal unit 503) which is received through the first error check reception processor 110, and if there is any missing frame, the frame continuity check processing which is the processing of controlling the start and stop of the recording of the information channel is performed by surveying the establishment or release of "call" of the information channel. Thereafter, the processing returns to step S51 to wait for reception of a next frame. The frame continuity check processing will be described lat-

is no information channel which is on standby for "connect", the processing immediately goes to step S76 to set a flag representing that frame missing occurs in all the information channels.

[0148] If the judgment that ISDN 502 does not receive from the communication terminal unit 503 the frame having the transmission sequence number which is registered as a missing frame is made on the basis of the reception sequence number of the frame which is newly received through the second error check reception processor 112 by the protocol controller 106b, the processing goes to step S77 to judge whether or not the value obtained by subtracting "1" from the newly received reception sequence number is larger than the maximum value of the transmission sequence numbers of the frames which have been received through the first error check reception processor 110 by the protocol controller 106b (the frames transmitted from the communication terminal unit 503).

[0149] Each of the reception and transmission sequence numbers is modulo (mod) 128 in which the numerical values from "0" to "127" are repeated. Therefore, the above judgment (comparison) is performed in consideration of the repeat frequency of the numeral values (the frequency of reset to zero).

[0150] If the value obtained by subtracting "1" from the reception sequence number of the frame (transmitted from ISDN 502) which is newly received through the second error check reception processor 112 by the protocol controller 106b is larger than the maximum value of the transmission sequence numbers of the frames (transmitted from the communication terminal unit 503) which have been received through the first error check reception processor 110 by the protocol controller 106b, it is resumed that frame missing occurs between ISDN 502 and the communication terminal unit 503 for some reason. In this case, the processing of the steps S74 to S76 is carried out as in the case of step S73, and the recording of the communication content on the information channel is started if necessary.

[0151] In step S78, it is judged whether or not the frame received through the first error check reception processor 110 is an information frame for the information channel in which a missing flag is set to ON. If the frame is not the information frame for the information channel in which the missing flag is set to ON, the flow is completed.

[0152] On the other hand, if the frame is the information frame for the information channel in which the missing flag is set to ON, the processing goes to step S79 to judge whether or not the frame contains a call proceeding message or an alerting message. If the frame contains the call proceeding message or the alerting message, the information channel processor 107 is controlled so that when the recording of the corresponding information channel has already been started, the recording is stopped (step S80), the missing flag of the information channel is then set to OFF (step S81), and this flow is then completed. If it is judged in step S79 that the frame contains no call proceeding message or no alerting message, the missing flag of the information channel concerned is immediately set to OFF (step S81), and this flow is completed.

[0153] According to the above-described third embodiment, the continuity of frames is surveyed by the sequence numbers affixed to the LAPD frames communicated on the signal channel, and if a frame missing occurs, it is surveyed whether the re-transmission procedure defined by the protocol between the communication terminal unit 503 and ISDN 502 is adopted.

[0154] If a surveying frame or an information frame is transmitted from the transmission destination (reception side) of the missing frame without using the re-transmission procedure based on the transmission of a re-transmission request frame, and a sequence number representing that the normal reception procedure is continued is affixed to this frame, it is judged that an error occurs in only the communication content recording apparatus 301, and the call proceeding based on voice communication is completed to start the recording of the information channel which waits for "connect".

[0155] With the above operation, even when a frame containing a connect or connect acknowledge message is partially or wholly missing, the recording operation of the communication content of the information channel can be controlled. Therefore, the lack of the communication content can be prevented.

[0156] In the present embodiment, the recording operation is stopped when an information frame containing a call proceeding message, an alerting message, a disconnect message, a release message or a release complete message with regard to the information channel under recording is received. With this operation, wasteful recording can be prevented.

[0157] In the present embodiment, even when a frame containing a disconnect message, a release message or a release complete message cannot be received, the control of the recording of the telephonic communication is performed on the basis of reception of a frame containing a next call proceeding message or alerting message, whereby the recording can be controlled on the basis of breaks in the telephonic communication.

[0158] Further, in the present embodiment, when an error is detected by the frame check sequence of the LAPD frame, the error frame is discarded by the first error check reception processor 110 and the second error check reception processor 112 without delivering the error frame to the protocol controller 106c, whereby the same processing procedure is applied to treat the missing of frames and error frames with no discrimination in the frame continuity check processing of the step S56 in Fig. 9.

[0159] In the present embodiment, when the information frame for controlling the information channel concerned is received on the signal channel for the infor-

result of said protocol processing means for a frame received subsequent to the error frame is not a retransmission request frame, said protocol controlling means presumes content of the error frame on the basis of the processing result of said protocol processing means for a frame received immediately before the error frame.

6. A communication content recording apparatus for recording contents of communications which are carried out through a digital communication network between communication terminal units, comprising:

receiving means for receiving data on a signal channel and data on an information channel which are received/transmitted between said digital communication network and said communication terminal units;
frame processing means for extracting a frame from the data on the signal channel received by said receiving means and outputting the frame thus extracted;
information channel processing means for processing the data on the information channel received by said receiving means so that the processed data can be recorded;
protocol controlling means for controlling start and stop of the processing of said information channel processing means according to a message contained in the frame output from said frame processing means; and
frame missing detection means for surveying continuity of frames output from said frame processing means to detect a missing frame, wherein when a frame missing is detected by said frame missing detection means, in accordance with a progress status of establishment or release procedure of a call of an information channel, said protocol controlling means controls start and stop of the processing of said information channel processing means for the information channel.

7. The communication content recording apparatus as claimed in claim 6, wherein when the frame extracted from the data on the signal channel received by said receiving means is an error, said frame processing means discards the frame without delivering the frame to said protocol controlling means.

8. The communication content recording apparatus as claimed in claim 6, wherein when a frame missing is detected by said frame missing detection means, said protocol controlling means judges, on the basis of a subsequently-output frame from said frame processing means, whether or not a reception procedure is correctly continued between said digital communication network and said communication terminal unit, and controls start and stop of the processing of said information channel processing means corresponding to an information channel concerned in accordance with a progress status of establishment or release procedure of a call of the information channel when reception procedure is judged to be correctly continued.

9. The communication content recording apparatus as claimed in claim 6, wherein in a case where the processing of said information channel processing means for the information channel is started on the basis of the detection of the frame missing by said frame missing detection means, when said protocol controlling means receives a frame on the signal channel to control the information channel concerned from said frame processing means, said protocol controlling means controls the processing of said information channel processing means for the information channel concerned according to a message contained in the frame concerned.

10. The communication content recording apparatus as claimed in claim 6, wherein when a frame received from said frame processing means contains a connect message or a connect acknowledge message for an information channel after the processing of said information channel processing means for the information channel is started on the basis of the detection of the frame missing by said frame missing detection means, said protocol controlling means discards data generated through the processing of said information channel processing means for the information channel concerned, and newly starts the processing of said information channel processing means for the information channel concerned.

11. The communication content recording apparatus as claimed in claim 6, wherein in a case where said protocol controlling means receives a frame containing a call proceeding message or an alerting message from said frame processing means in a state where said protocol controlling means received no frame containing a disconnect message, a release message and a release complete message from said frame processing means, when the processing of said information channel processing means for the information channel corresponding to the message concerned is carried out, said protocol controlling means stops the processing.

12. The communication content recording apparatus as claimed in claim 6, wherein when said protocol controlling means receives a frame containing any one of a call proceeding message, an alerting message, a disconnect message, a release message and a release complete message for the information

FIG.1

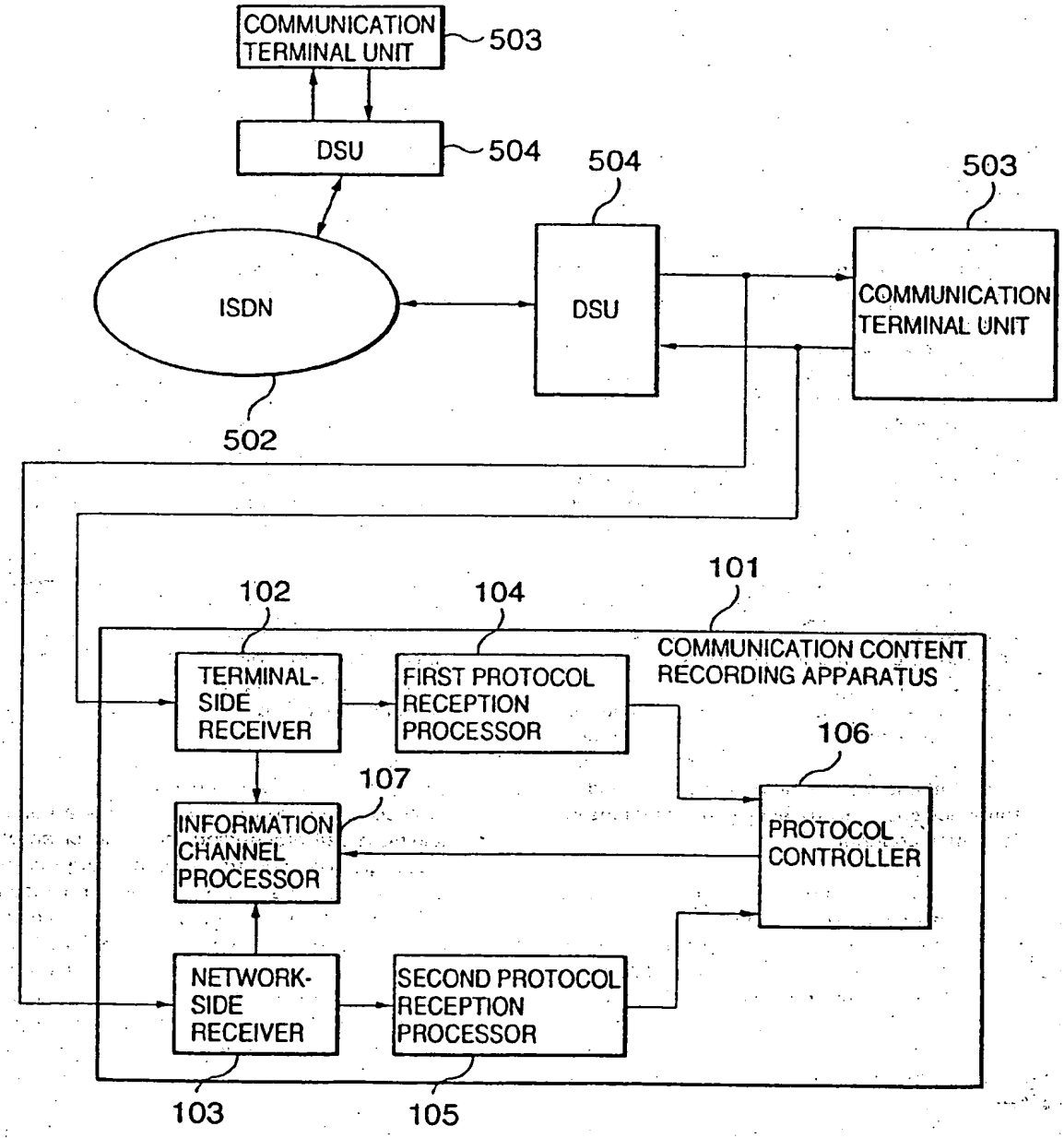

COMMUNICATION TERMINAL UNIT
503
DSU
504
504
503
ISDN
DSU
COMMUNICATION TERMINAL UNIT
502
101
102
104
COMMUNICATION CONTENT RECORDING APPARATUS
TERMINAL-SIDE RECEIVER
FIRST PROTOCOL RECEPTION PROCESSOR
106
107
INFORMATION CHANNEL PROCESSOR
PROTOCOL CONTROLLER
NETWORK-SIDE RECEIVER
SECOND PROTOCOL RECEPTION PROCESSOR
103
105

FIG.3

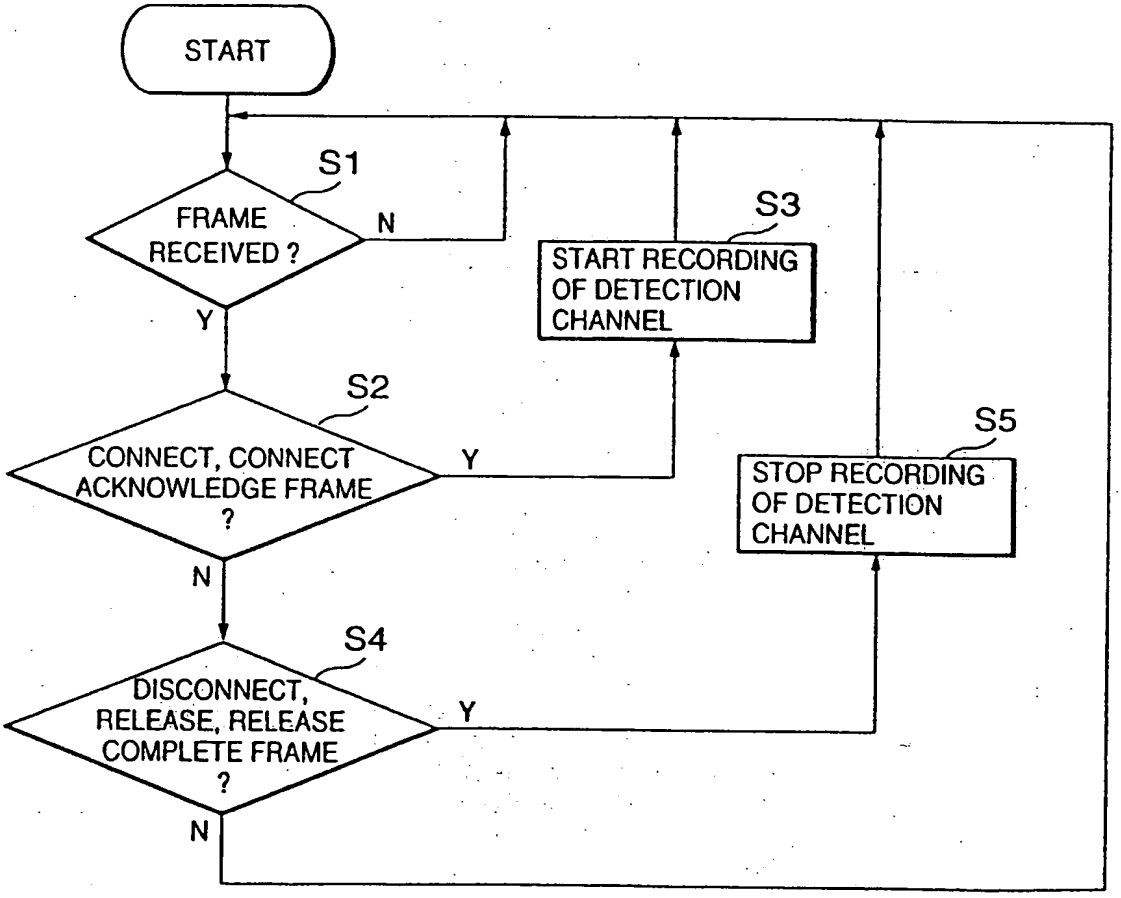

START
S1
FRAME RECEIVED ?
N
Y
S2
CONNECT, CONNECT ACKNOWLEDGE FRAME ?
Y
N
S3
START RECORDING OF DETECTION CHANNEL
S4
DISCONNECT, RELEASE, RELEASE COMPLETE FRAME ?
Y
N
S5
STOP RECORDING OF DETECTION CHANNEL

FIG.5

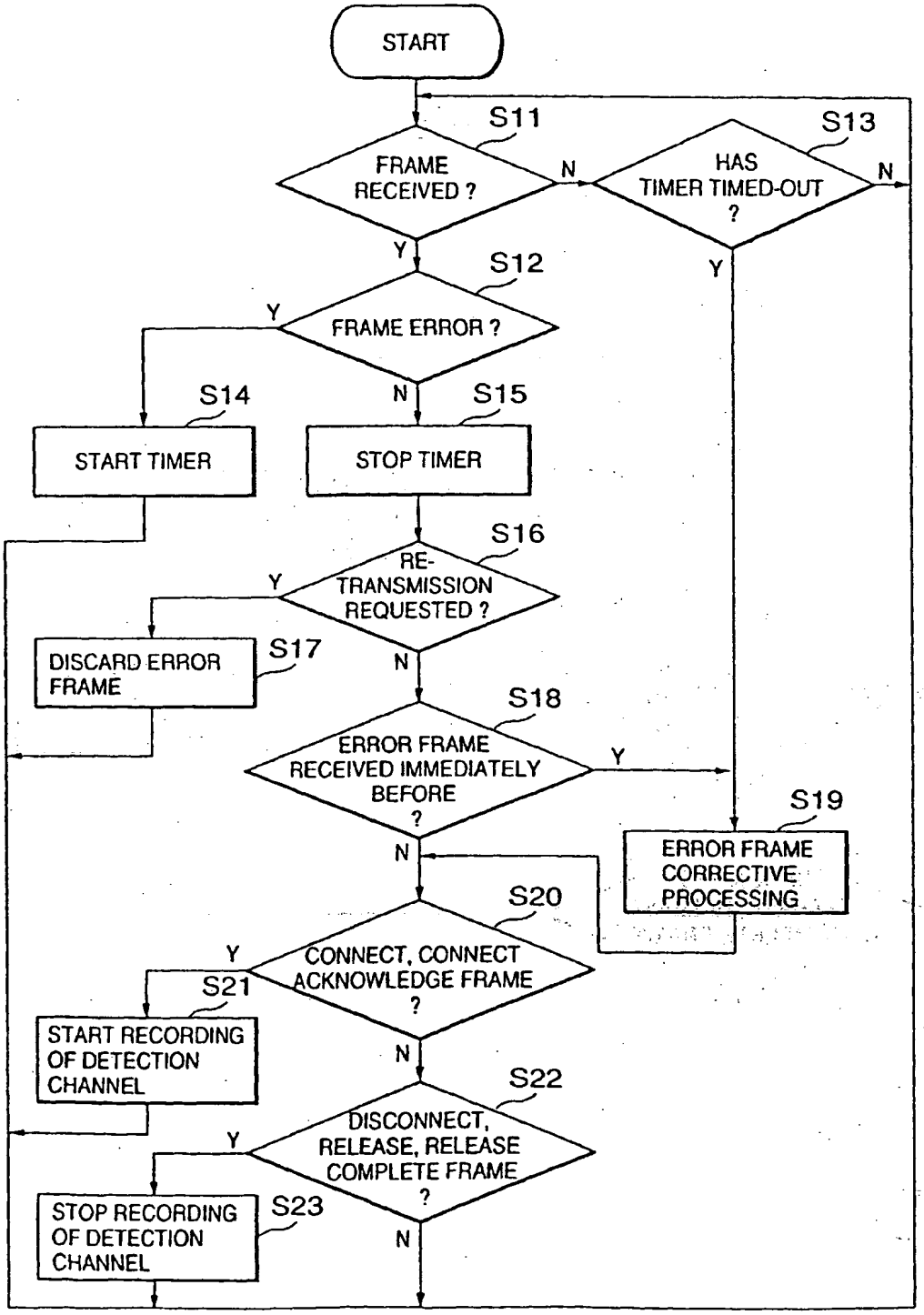

START
S11
FRAME RECEIVED ?
N
S13
HAS TIMER TIMED-OUT ?
N
Y
Y
S12
FRAME ERROR ?
Y
N
S14
START TIMER
S15
STOP TIMER
S16
RE-TRANSMISSION REQUESTED ?
Y
N
DISCARD ERROR FRAME
S17
S18
ERROR FRAME RECEIVED IMMEDIATELY BEFORE ?
Y
N
S19
ERROR FRAME CORRECTIVE PROCESSING
S20
CONNECT, CONNECT ACKNOWLEDGE FRAME ?
Y
N
S21
START RECORDING OF DETECTION CHANNEL
S22
DISCONNECT, RELEASE, RELEASE COMPLETE FRAME ?
Y
N
STOP RECORDING OF DETECTION CHANNEL
S23

FIG.7

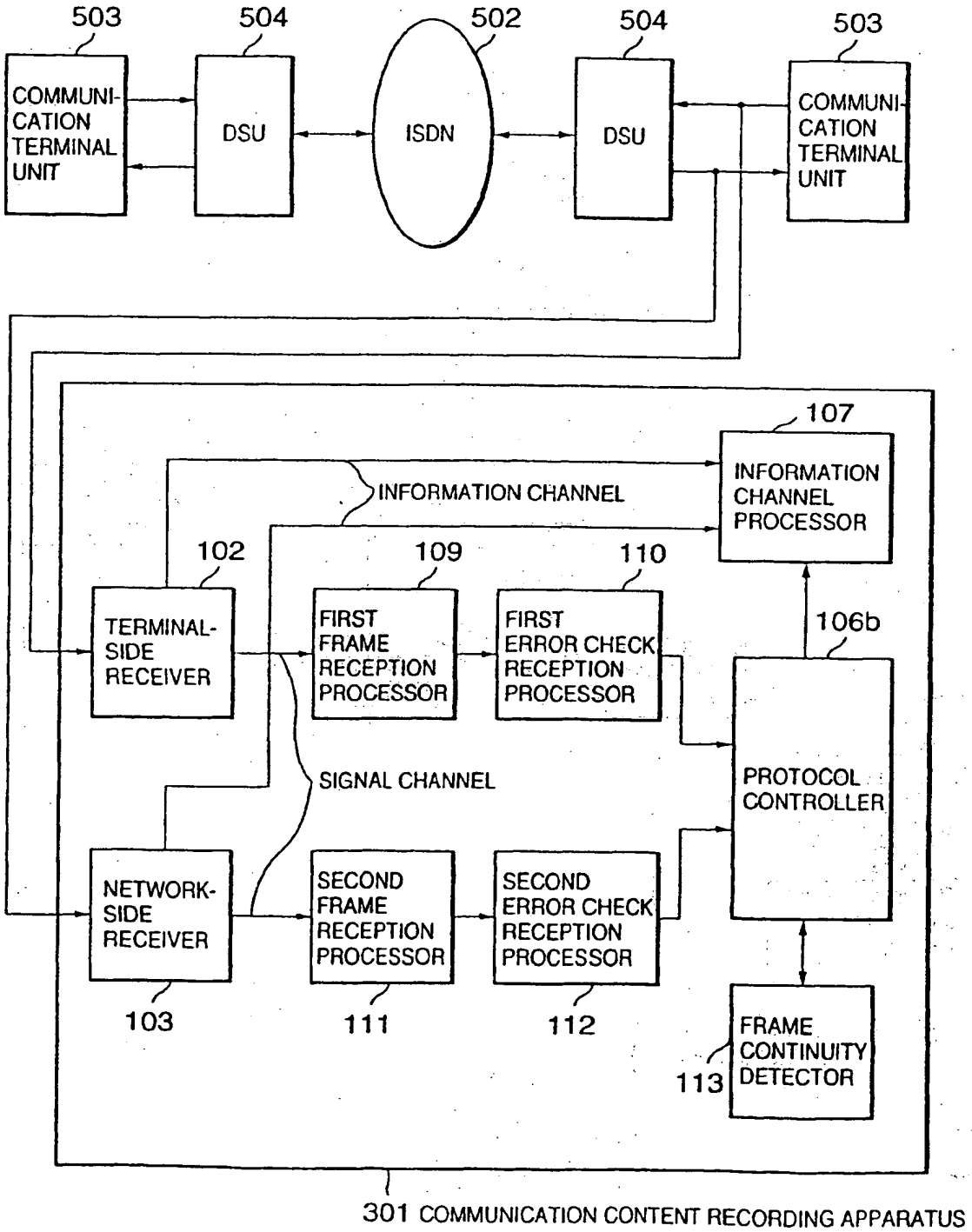

503
504
502
504
503
COMMUNI-CATION TERMINAL UNIT
DSU
ISDN
DSU
COMMUNI-CATION TERMINAL UNIT
107
INFORMATION CHANNEL PROCESSOR
INFORMATION CHANNEL
102
109
110
TERMINAL-SIDE RECEIVER
FIRST FRAME RECEPTION PROCESSOR
FIRST ERROR CHECK RECEPTION PROCESSOR
106b
SIGNAL CHANNEL
PROTOCOL CONTROLLER
NETWORK-SIDE RECEIVER
SECOND FRAME RECEPTION PROCESSOR
SECOND ERROR CHECK RECEPTION PROCESSOR
103
111
112
FRAME CONTINUITY DETECTOR
113
301 COMMUNICATION CONTENT RECORDING APPARATUS

FIG.9

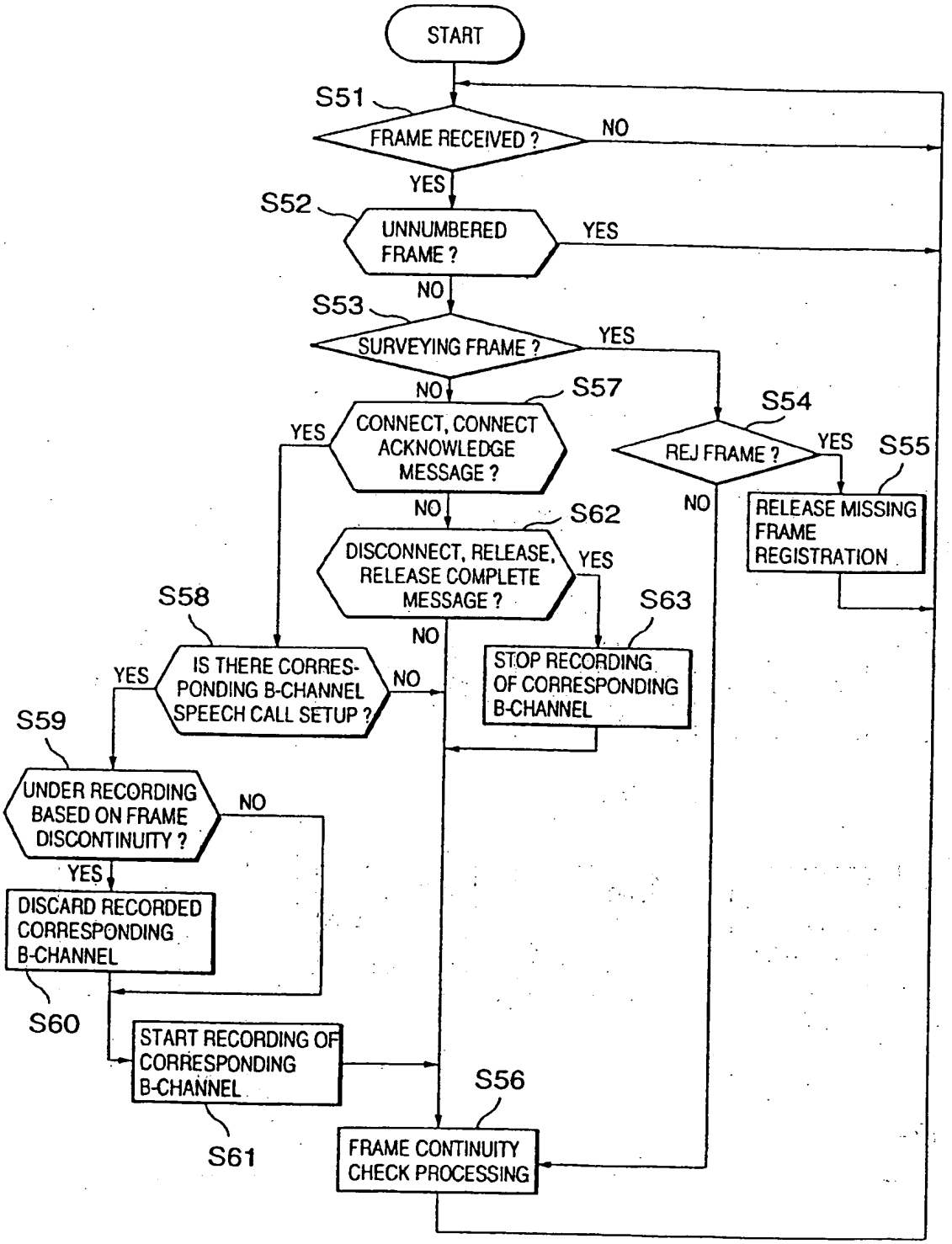

START
S51
FRAME RECEIVED ?
NO
YES
S52
UNNUMBERED FRAME ?
YES
NO
S53
SURVEYING FRAME ?
YES
NO
S57
CONNECT, CONNECT ACKNOWLEDGE MESSAGE ?
YES
S54
REJ FRAME ?
YES
S55
NO
RELEASE MISSING FRAME REGISTRATION
NO
S62
DISCONNECT, RELEASE, RELEASE COMPLETE MESSAGE ?
YES
S63
NO
STOP RECORDING OF CORRESPONDING B-CHANNEL
S58
IS THERE CORRESPONDING B-CHANNEL SPEECH CALL SETUP ?
YES
NO
S59
UNDER RECORDING BASED ON FRAME DISCONTINUITY ?
NO
YES
DISCARD RECORDED CORRESPONDING B-CHANNEL
S60
START RECORDING OF CORRESPONDING B-CHANNEL
S61
S56
FRAME CONTINUITY CHECK PROCESSING

FIG.11

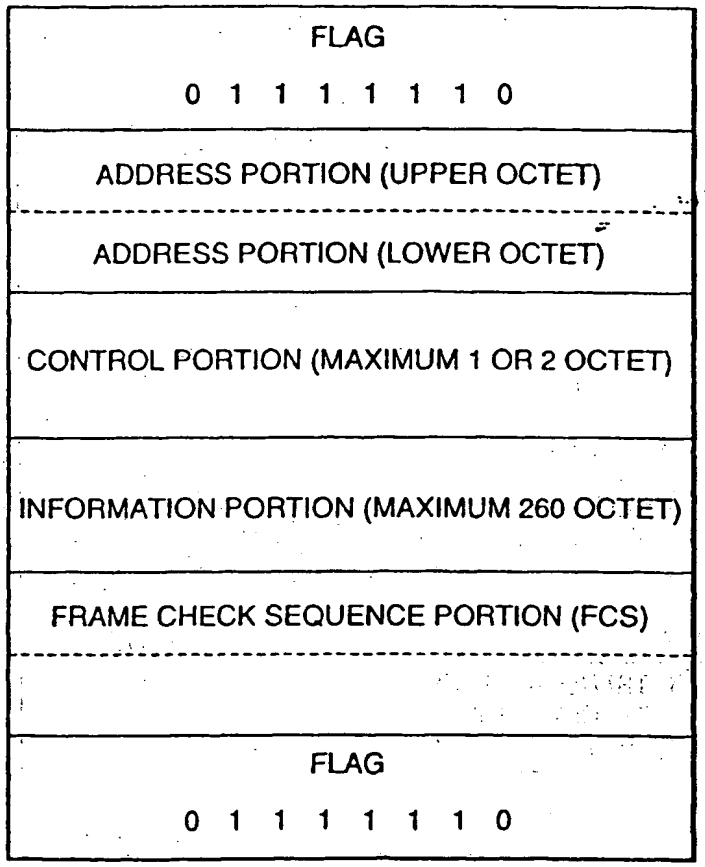
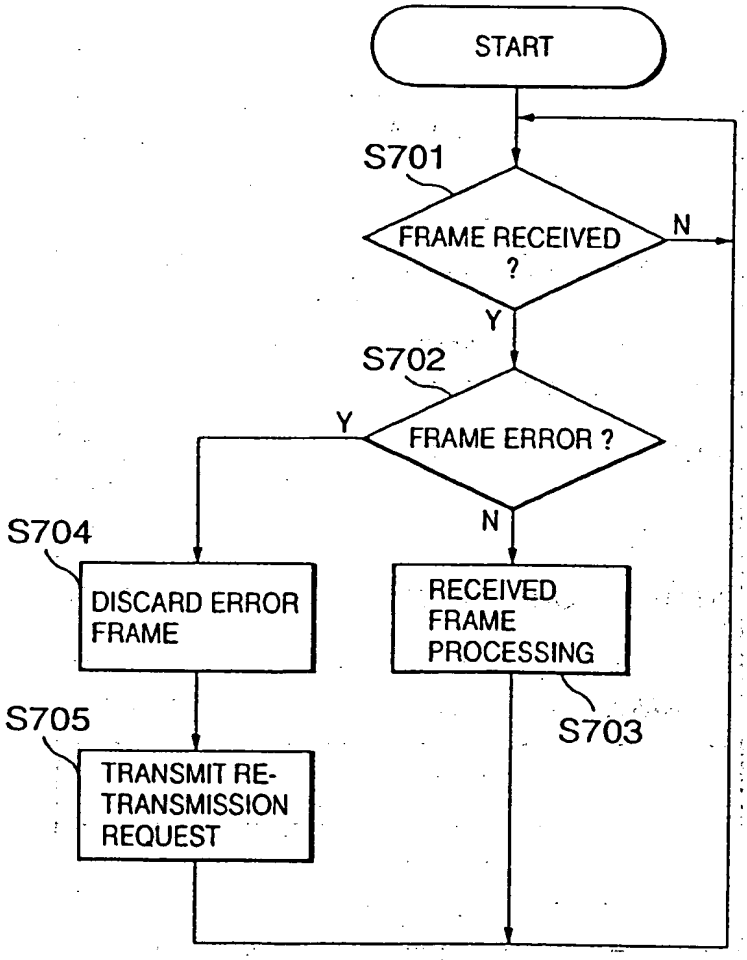

FLAG
0 1 1 1 1 1 1 0
ADDRESS PORTION (UPPER OCTET)
ADDRESS PORTION (LOWER OCTET)
CONTROL PORTION (MAXIMUM 1 OR 2 OCTET)
INFORMATION PORTION (MAXIMUM 260 OCTET)
FRAME CHECK SEQUENCE PORTION (FCS)
FLAG
0 1 1 1 1 1 1 0

FIG.13


START
S701
FRAME RECEIVED ?
N
Y
S702
FRAME ERROR ?
Y
N
S704
DISCARD ERROR FRAME
RECEIVED FRAME PROCESSING
S703
S705
TRANSMIT RE-TRANSMISSION REQUEST